REMARKS

Claim objections

Claim 1 has been objected to for lacking a comma in the second paragraph. Claim 1 has been amended as suggested by the Examiner. Withdrawal of the rejection is respectfully requested.

Rejections under 35 U.S.C. §112, second paragraph

Claim 1 has been rejected under 35 U.S.C. §112, second paragraph as being unclear with regard to paragraph 5. The fifth paragraph of claim 1 has been amended to more clearly state that "if only a portion of the substrate is covered by the anode, optionally also depositing the third layer on top of at least some of the portion of the substrate not covered by the anode." In addition, the second paragraph of claim 1 has been amended to provide antecedent basis for "substrate." Withdrawal of the rejection is respectfully requested.

Rejections under 35 U.S.C. §102(b) and 103

Claims 1 and 5-50 have been rejected under 35 U.S.C. §102(b) as being anticipated by Cao (U.S. Pat. No. 5,965,281). Claims 10 and 21 have been rejected under 35 U.S.C. §103 as being obvious over Cao (U.S. '281) combined with Yu et al. (U.S.

Pat. No. 6,441,395). Applicants traverse this rejection and withdrawal thereof is respectfully requested.

On pages 3 and 4 of the Office Action, the Examiner asserts that Cao '281 teaches a device having:

1) a first layer 14, which may be a conducting material selected from calcium, manganese, ITO, aluminum, nickel, copper, silver etc. or a semiconducting material selected from silicon, germanium or gallium arsenide;

2) a second layer 16, made from a conducting polymer, wherein the second layer has a higher work function than the first polymer layer (the Examiner points to Example 8 with regard to this feature;

3) a third layer (either 24 or 16) of semiconducting organic material on top of the anode; and

4) a fourth cathode layer 18.

The Examiner newly relies on U.S. Pat. No. 5,798,170 for the general teaching that if a conducting polymer with a higher work function is placed on a first layer, the work function of the anode will become equal to that of the conducting polymer.

Briefly, Cao '281 fails to anticipate the present invention of claim 1 because the disclosure in Cao '281 is "missing" a layer of the present invention. The Examiner equates layer 16 of Cao et al. to the second layer of the invention. However, if layer 16 of Cao '281 is equated to the second layer of the

present invention, then the third layer of the invention is missing from the reference because layer 24 of Cao '281 is conducting. Contrary to the assertion of the Examiner, layer 24 of Cao '281 cannot function as the third layer of the invention. On the other hand, if layer 16 of Cao '281 is equated to the third semiconducting layer of the invention, as alternatively presented by the Examiner, then the second conducting polymer layer of the invention is missing. As such, Cao '281 fails to anticipate the present invention.

The differences in Cao '281 and the present invention are discussed in further detail in the following remarks. The first layer 14 of Cao '281, which is the anode layer, is made with the materials as stated in col. 10, lines 16-38. Cao '281 states that the anode layer can be a transparent conductive layer made of a material with a work function above 4.5 volt, but also includes materials which typically have a lower work function, e.g. aluminium.

The cathode layer of Cao '281 is discussed in col.10, lines 38-46 wherein it is stated that the cathode is fabricated from a high work function metal and that high work function metals are those with the work function equal to or larger than 4.0. Essentially the work function of the hole-injecting anode is substantially higher than that of the electron-injecting cathode. It is common knowledge that with light-emitting

devices the work function of the anode must be higher than the work function of the cathode.

The second layer 16 of Cao '281 is an electroluminescent, i.e. a semiconducting polymer. See column 6 of Cao '281 where it is clearly stated that the active layer 16 is an electronically active organic polymer and mixed with an additive. Optionally a conducting polymer grid 24 can be embedded in the layer 16 and used for improving the performance of the device in a manner similar to the application of a grid voltage in a classic vacuum triode (Cao '281, col. 6, lines 28-34).

It should be noted that with the present invention, the conducting polymer is part of a bilayer anode composed of the polymer and a base metal or an inorganic semiconductor (first and second layers). Moreover the anode of the present invention is not transparent. An anode as encompassed by claim 1 is not disclosed at all in Cao '281 and the appearance of layer 16 in fig. 15 only shows the use of the embedded conducting polymer 24. Concerning example 8, Cao '281 here discloses the use of ITO coated by hole-injecting conducting polymers, which may be PEDOT-PSS. However the work function of ITO is roughly similar to PEDOT-PSS, and one of the main points of the present invention was to avoid the use of ITO and noble metals, which have been shown to be detrimental to a conducting polymer layer.

In addition, the device of Cao '281 must have a semiconducting light-emitting polymer, viz. layer 16, in order to function. The embodiment shown in fig. 14 of Cao '281 is a light-emitting device with a semiconducting, light-emitting polymer 16 next to the anode and an electron-injecting polymer layer 22 between the light-emitting semiconducting polymer and the transparent anode 14.

Fig. 13 of Cao '281 only shows the light-emitting semiconducting polymer 16 between the anode 14 and the cathode 18. It is inherent that the layer 16 cannot be a conducting polymer as this would serve to short-circuit the whole device, and moreover generate no light emission.

If a third layer were used, it would be the cathode in fig. 13 of Cao '281. The light-emitting semiconducting polymer is denoted 16 in the embodiment in fig. 14, while in the embodiment in fig. 15, the light-emitting semiconducting polymer remains 16, but with a conducting polymer grid 24 embedded in the layer 16, as discussed above. The cathode of Cao '281 is common prior art, i.e. it is well known that any good metallic conductor with a fairly low work function for injecting electrons into the semiconducting layer 16 would serve as the cathode.

Neither the primary reference of Cao '281 nor either of the secondary references of Yu '395 or Zhang '170, pertains to a non-photovoltaic device, i.e. a rectifying diode or a rectifying

junction as is the case of the present invention and all of the references fail to teach the high rectification ratio obtainable with the present invention. Nor is there any suggestion of the high rectification ratio obtainable with the present invention in any of the references as this particular property is of no concern with light-emitting diodes where the dark current rectification ratio is 3 to 4 orders of magnitude lower than that of the present invention.

Zhang '170 teaches in col. 6 under the "The higher work function electrode 16" that it is recommended to use a highly conducting polymer such as PANI for the anode electrode, as it has a higher work function and better hole injection into the polymer active layer than does the ITO electrode. Due to the high surface resistance of conducting polymers such as PANI, Zhang '170 proposes using ITO covered with a conducting polymer layer. But as noted, a very thin conducting polymer layer in the anode is not compatible with materials such as ITO or any noble metal as used in the anode.

Thus, as discussed above, the present invention is not disclosed in Cao '281 because Cao '281 fails to disclose each feature of the invention and no matter how Cao '281 is interpreted, a layer of the present invention is missing from the reference. Even with Example 8 of Cao, which is the closest disclosure to the present invention in that a bilayer anode is

used, a combination that is neither required nor desirable in the present invention is disclosed. If the Examiner's interpretation of the properties of layers 16 of Cao '281 was correct, neither of the device configurations shown in figs. 13 and 14 of Cao '281 would be able to function at all. The secondary references of Zhang '170 and Yu '395 fail to compensate for the deficiencies in Cao '281. As such, the present invention is neither anticipated by nor obvious over the cited references. Withdrawal of the rejections and allowance of the claims are therefore respectfully requested.

Should the Examiner have any questions regarding the present application, he is requested to please contact MaryAnne Armstrong, PhD (Reg. No. 40,069) in the Washington DC area at (703) 205-8000.

A marked-up copy of claim 1, showing all changes is attached hereto.

If necessary, the Commissioner of hereby authorized in this, concurrent, and future replies, to charge payment or credit any overpayment to Deposit Account No. 02-2448 for any additional fees required under 37 C.F.R. § 1.16 or under § 1.17; particularly, extension of time fees.

Respectfully submitted,

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VERSION WITH MARKINGS TO SHOW CHANGE MADE

IN THE CLAIMS:

Claim 1 has been amended as follows:

1. (Twice Amended) A method in the fabrication of an electrode structure for an organic thin-film semiconducting device, wherein the semiconducting device is a rectifying diode with a high rectification ratio of an organic thin-film transistor or a hybrid organic/inorganic thin-film transistor comprises

forming a first layer of a base metal, a semiconducting material or as a combination of a base metal and a semiconducting material **on a substrate**,

depositing a second layer of a conducting polymer on the first layer, said conducting polymer being selected among conducting polymers with a work function greater than the work function of the first layer, such that the real work function of the electrode structure in any case becomes equal to the work function of the selected conducting polymer, and providing the electrode structure in the semiconducting device such that the second layer contacts at least a portion of an active organic semiconductor material in said semiconducting device,

modifying the work function of the conducting and/or semiconducting material of the first layer by depositing a

second layer of a conducting polymer with a work function higher than that of the material in the first layer such that the layer of the conducting polymer mainly covers the first layer or is conformal with the latter, whereby the combination of the first layer and second layer constitutes the anode of the electrode arrangement and the work function of the anode becomes substantially equal to that of the conducting polymer,

depositing a third layer of semiconducting organic material on top of the anode~~, and optionally and in case~~ **and if** only a portion of the substrate is covered by the anode, **optionally** also **depositing the third layer on top of** ~~above~~ at least some of the portion of the substrate not covered by the anode, and

depositing a patterned or non-patterned fourth layer of a metal on the tope of the third layer, whereby the fourth layer constitutes the cathode of the electrode arrangement.